CLAIMS

What is claimed is:

1.   An echo canceler circuit comprising:

a double talk activity probability data generator operative to receive pre-echo canceler uplink data and in response to produce double talk activity probability data; and

an echo canceler stage, operatively coupled to the double talk activity probability data generator and operative to receive downlink data, the pre-echo canceler uplink data and the double talk activity probability data and in response to produce attenuated uplink data.

2.   The echo canceler circuit of claim 1 wherein the echo canceler stage includes an echo canceler adaptive filter operatively coupled to the double talk activity probability data generator and operative to receive the double talk activity probability data and the attenuated downlink data and in response to produce echo estimation data and to adjust a rate of echo cancellation adaptation.

3.   The echo canceler circuit of claim 1 wherein the echo canceler stage further includes:

adder logic operative to receive the pre-echo canceler uplink data and echo estimation data and in response to produce post-echo canceler uplink data;

an uplink data attenuator, operatively coupled to the adder logic, and operative to receive the post-echo canceler uplink data and the double talk activity probability data and in response to attenuate the post-echo canceler uplink data to produce the attenuated uplink data.

4.   The echo canceler circuit of claim 1 wherein the double talk activity probability data generator further includes:

a center power clipped data generator operative to receive the pre-echo canceler uplink data and in response to produce center power pre-clipped data and clipped center power data;

a center to composite power ratio data generator operative to receive the pre-echo canceler uplink data and the center power pre-clipped data and in response to produce center to composite power ratio data;

a distortion data generator operative to receive the pre-echo canceler uplink data and in response to produce distortion data; and

double talk soft decision logic operatively coupled to the center power clipped data generator, the center to composite power ratio data generator and the distortion data generator and operative to receive the clipped center power data, the center to composite power ratio data and the distortion data and in response to produce the double talk activity probability data.

5.   The echo canceler circuit of claim 4 wherein the center power clipped data generator further includes:

a center band pass filter operative to receive the pre-echo canceler uplink data and in response to produce center band pass data;

center clipper logic operatively coupled to the center band pass filter and operative to receive the center band pass data and in response to produce center clipped band pass data;

pre-clipping power estimate logic operatively coupled to the center band pass filter and operative to receive the center band pass data and in response to produce the center power pre-clipped data; and

post-clipping power estimate logic operatively coupled to the center

clipper logic and operative to receive the center clipped band pass data and in

response to produce the clipped center power data.

6.   The echo canceler circuit of claim 5 wherein the center to composite power

ratio data generator further includes:

        a lower band pass filter operative to receive the pre-echo canceler

uplink data and in response to produce lower band data;

        an upper band pass filter operative to receive the pre-echo canceler

uplink data and in response to produce upper band data;

        adder logic operatively coupled to the lower band pass filter and to the

upper band pass filter and operative to receive the lower band data and the upper band

data and in response to produce composite band data;

        composite power estimate logic operatively coupled to the adder logic

and operative to receive the composite band data and in response to produce

composite power data; and

        a center to composite power ratio data generator operatively coupled to

the composite power estimate logic and to the pre-clipping power estimate logic and

operative to receive the composite power data and the center power pre-clipped data

and in response to produce the center to composite power ratio data.

7.   An echo canceler circuit comprising:

        a double talk activity probability data generator operative to receive

pre-echo canceler uplink data and in response to produce double talk activity

probability data;

27

a pre-processor, operatively coupled to the double talk activity probability data generator, and operative to receive downlink data and the double talk activity probability data and in response to produce attenuated downlink data;

adder logic operatively coupled to receive the pre-echo canceler uplink data and echo estimation data and in response to produce post-echo canceler uplink data;

a post-processor, operatively coupled to the double talk activity probability data generator and to the adder logic, and operative to receive the post-echo canceler uplink data and the double talk activity probability data and in response to attenuate the post-echo canceler uplink data to produce attenuated uplink data.

8.   The echo canceler circuit of claim 7 wherein the pre-processor includes a downlink data attenuator operative to receive the downlink data and the double talk activity probability data and in response to attenuate the downlink data to produce the attenuated downlink data, and wherein the post-processor includes an uplink data attenuator operative to receive the post-echo canceler uplink data and the double talk activity probability data and in response to attenuate the post-echo canceler uplink data to produce the attenuated uplink data.

9.   The echo canceler circuit of claim 7 further including:

an echo canceler adaptive filter, operatively coupled to the adder logic, the pre-processor and to the double talk activity probability data generator, and operative to receive the attenuated downlink data and the double talk activity probability data and in response to produce the echo estimation data and to change a rate of echo cancellation adaptation.

10.   The echo canceler circuit of claim 8 further including:

a digital-to-analog converter, operatively coupled to the downlink data attenuator, and operative to receive the attenuated downlink data and in response to produce a downlink audio signal;

an amplifier, operatively coupled to the digital-to-analog converter, and operative to receive the downlink audio signal and in response to produce an amplified downlink audio signal;

a microphone, operatively coupled to receive at least a portion of the amplified downlink audio signal and in response to produce a pre-echo canceler uplink signal; and

an analog-to-digital converter, operatively coupled to the microphone, the adder logic and to the double talk activity probability generator, and operative to receive the pre-echo canceler uplink signal and in response to produce the pre-echo canceler uplink data.

11.   A communication apparatus comprising:

a housing having coupled therewith:

an echo canceler circuit within the housing comprising:

a double talk activity probability data generator operative to receive pre-echo canceler uplink data and in response to produce double talk activity probability data;

an echo canceler stage, operatively coupled to the double talk activity probability data generator, and operative to receive downlink audio data, the pre-echo canceler uplink data and the double talk activity probability data and in response to produce the attenuated uplink data; and

a transceiver within the housing, operatively coupled to the echo

canceler stage, and operative to receive the attenuated uplink data and in response to

transmit the attenuated uplink data.

12.   The communication apparatus of claim 11 wherein the transceiver is at least

one of: a wireless wide area network (WWAN) transceiver and a wireless local area network

(WLAN) transceiver.

13.   The communication apparatus of claim 12 further including a location

information generator operative to produce location information, wherein the echo canceler

circuit includes:

one or more processing devices operatively coupled to the location

information generator; and

memory operatively coupled to the one or more processing devices,

containing instructions executable by the one or more processing devices to cause the

one or more processing devices to receive the location information from the location

information generator and in response to provide the location information to the

transceiver, wherein the transceiver transmits the location information.

14.   The communication apparatus of claim 11 wherein the transceiver receives

downlink audio data and in response provides the downlink audio data to the echo canceler

circuit.

15.   An in-vehicle communication system comprising:

an echo canceler circuit comprising:

a double talk activity probability data generator operative to

receive pre-echo canceler uplink data and in response to produce double talk activity

probability data;

an echo canceler stage, operatively coupled to the double talk

activity probability data generator, and operative to receive downlink data, the pre-

echo canceler uplink data, and the double talk activity probability data and in response

to produce attenuated uplink data;

a wireless transceiver operatively coupled to the echo canceler stage

and operative to receive the attenuated uplink data and in response to transmit the

attenuated uplink data;

an audio system including:

an amplifier, operatively coupled to the echo canceler circuit,

and operative to receive attenuated downlink data and in response to produce an

amplified downlink audio signal; and

a playback system including at least one of: a tuner circuit, a

tape player, a CD player, a DVD player and a hard drive, operatively coupled to the

amplifier and operative to provide at least a playback audio signal to the amplifier.

16.   The in-vehicle communication system of claim 15 wherein the transceiver is at

least one of: a wireless wide area network (WWAN) transceiver, a wireless local area

network (WLAN) transceiver, and a wireless device.

17.   The in-vehicle communication system of claim 15 wherein the echo canceler

stage includes an echo canceler adaptive filter operatively coupled to the double talk activity

probability data generator and operative to receive the double talk activity probability data

and the attenuated downlink data and in response to produce echo estimation data and to

reduce a rate of echo cancellation adaptation.

18.   The in-vehicle communication system of claim 15 further including a

microphone operative to receive at least a portion of the amplified downlink audio signal and

in response to produce the pre-echo canceler uplink signal.

19.   The in-vehicle communication system of claim 15 further including at least one speaker, operatively coupled to the amplifier, and operative to receive the amplified downlink audio signal and in response to acoustically produce the amplified downlink audio signal.

20.   A method for detecting double talk activity comprising:

generating double talk activity probability data in response to pre-echo canceler uplink data; and

echo canceling the pre-echo canceler uplink data in response to the double talk activity probability data to produce attenuated uplink data.

21.   The method of claim 20 including:

attenuating downlink data in response to the double talk activity probability data to produce attenuated downlink data.

22.   The method of claim 20 including reducing a rate of echo cancellation adaptation in response to the double talk activity probability data.

23.   Memory containing instructions executable by one or more processing devices that causes the one or more processing devices to:

generate double talk activity probability data in response to pre-echo canceler uplink data; and

echo cancel the pre-echo canceler uplink data in response to the double talk activity probability data to produce attenuated downlink data.

24.   The memory of claim 23 containing executable instructions that cause the one or more processing devices to:

attenuate downlink data in response to the double talk activity probability data to produce attenuated downlink data.

25.   The memory of claim 23 containing executable instructions that cause the one

or more processing devices to:

reduce a rate of echo cancellation adaptation in response to the double

talk activity probability data.